The 10.35 μm Band: A More Appropriate Window Band for the GOES-R ABI Than 11.2 μm?

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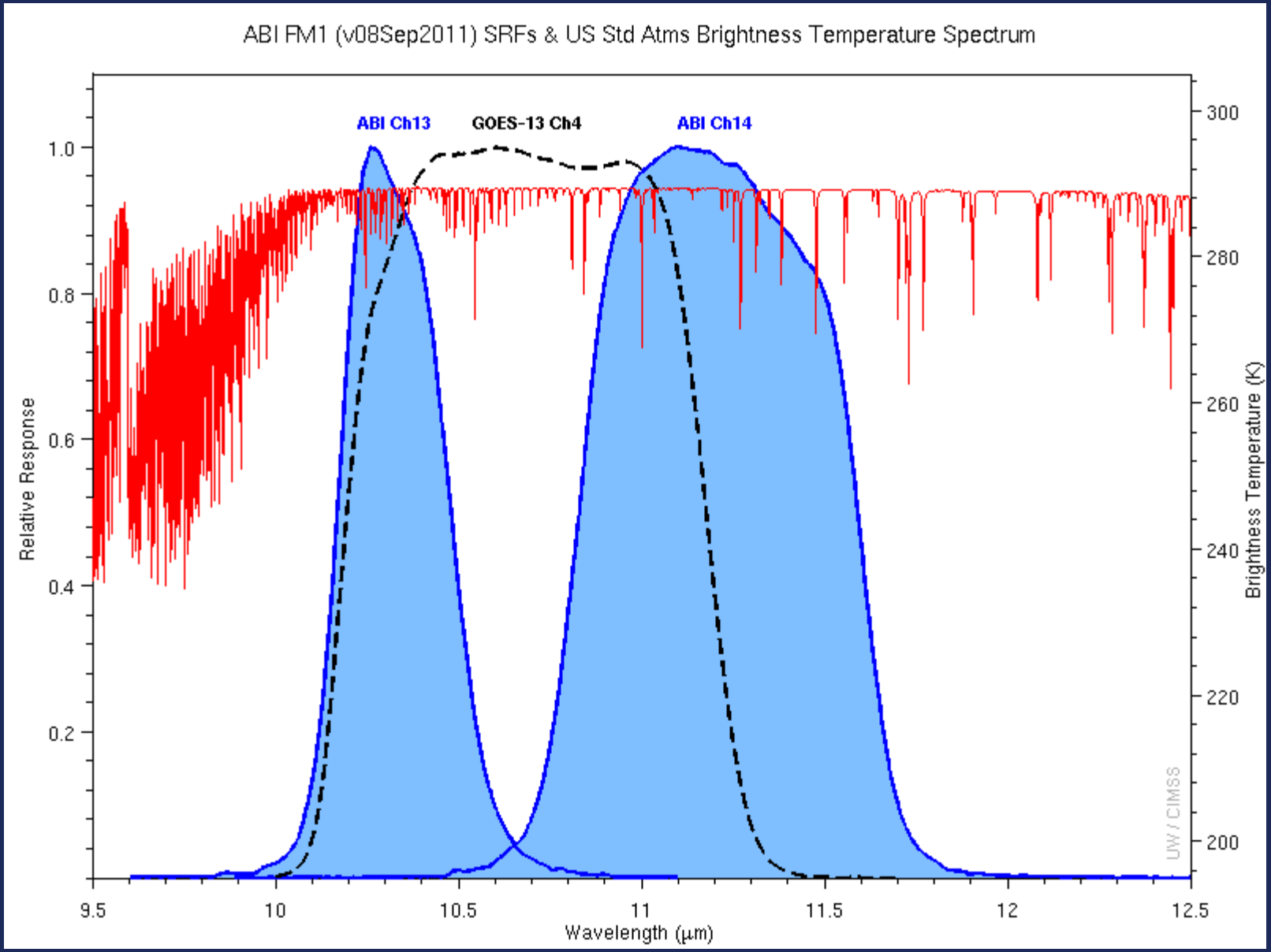
Background

- The Advanced Baseline Imager (ABI) will have two channels in the Infrared Window portion of the spectrum: one centered at 10.35 µm and one at 11.2 µm
- The 11.2 µm band is near window channels aboard other imagers:
  - GOES-8 to -15 (10.7 µm)
  - SEVIRI (10.8 µm)
  - MODIS (11.0 µm)
  - VIIRS (10.8 and 11.4 µm)
- No broad-band space-borne instrument has a band centered near 10.3 µm, so the ABI will be breaking new ground
- The MODIS Airborne Simulator (MAS) had a band centered at 10.55 µm, but this channel was ultimately excluded from the MODIS instrument
- Based on the MAS experience, this band was first suggested to be on the ABI by Paul Menzel

Questions

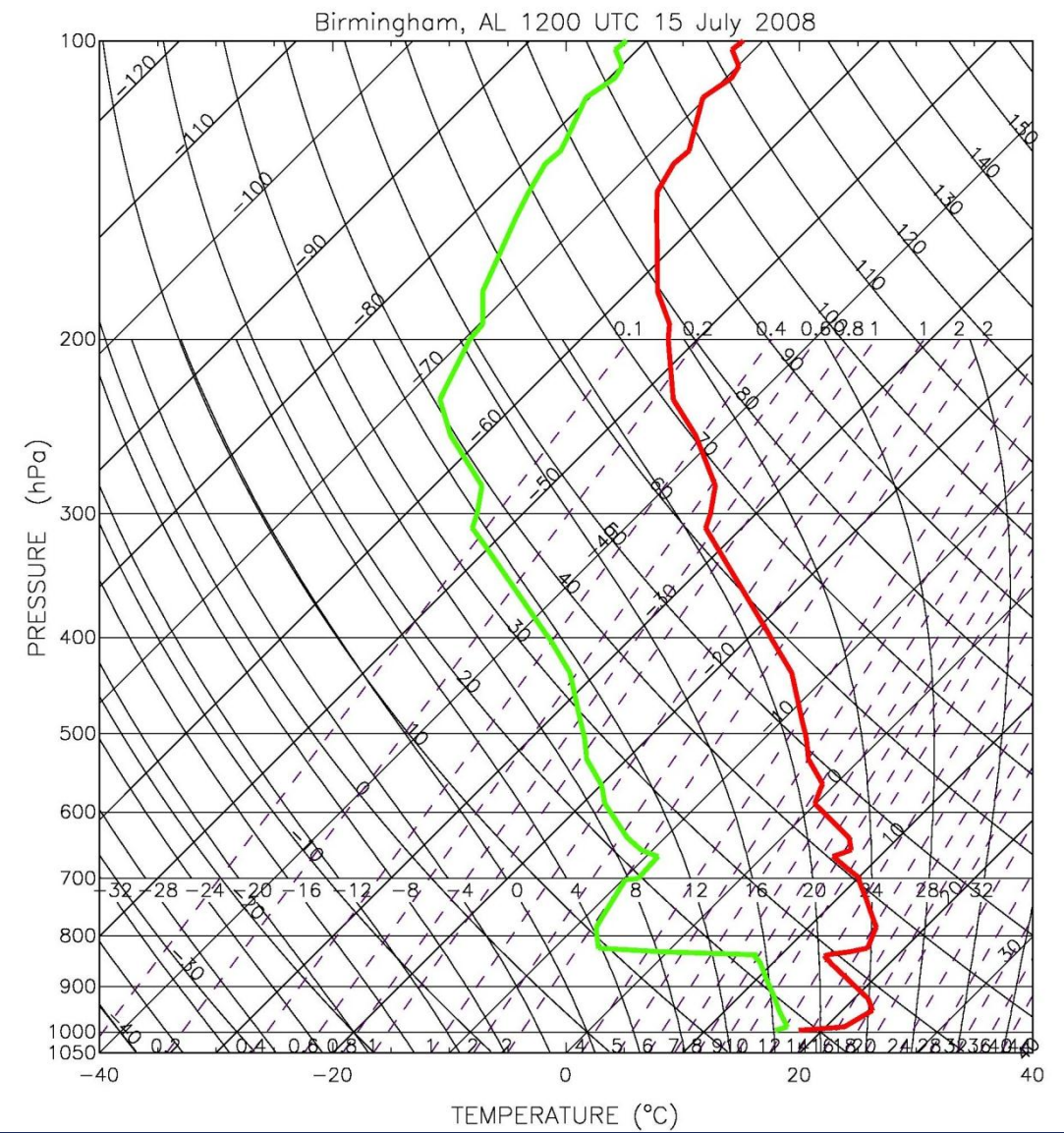
1. What are the relative advantages of the 10.35 and 11.2 μm channels?
2. Should one of them be the “default” Window IR Band?
3. For algorithm development, which Window band is more appropriate, or should both be used?

Two ABI bands in this spectral region



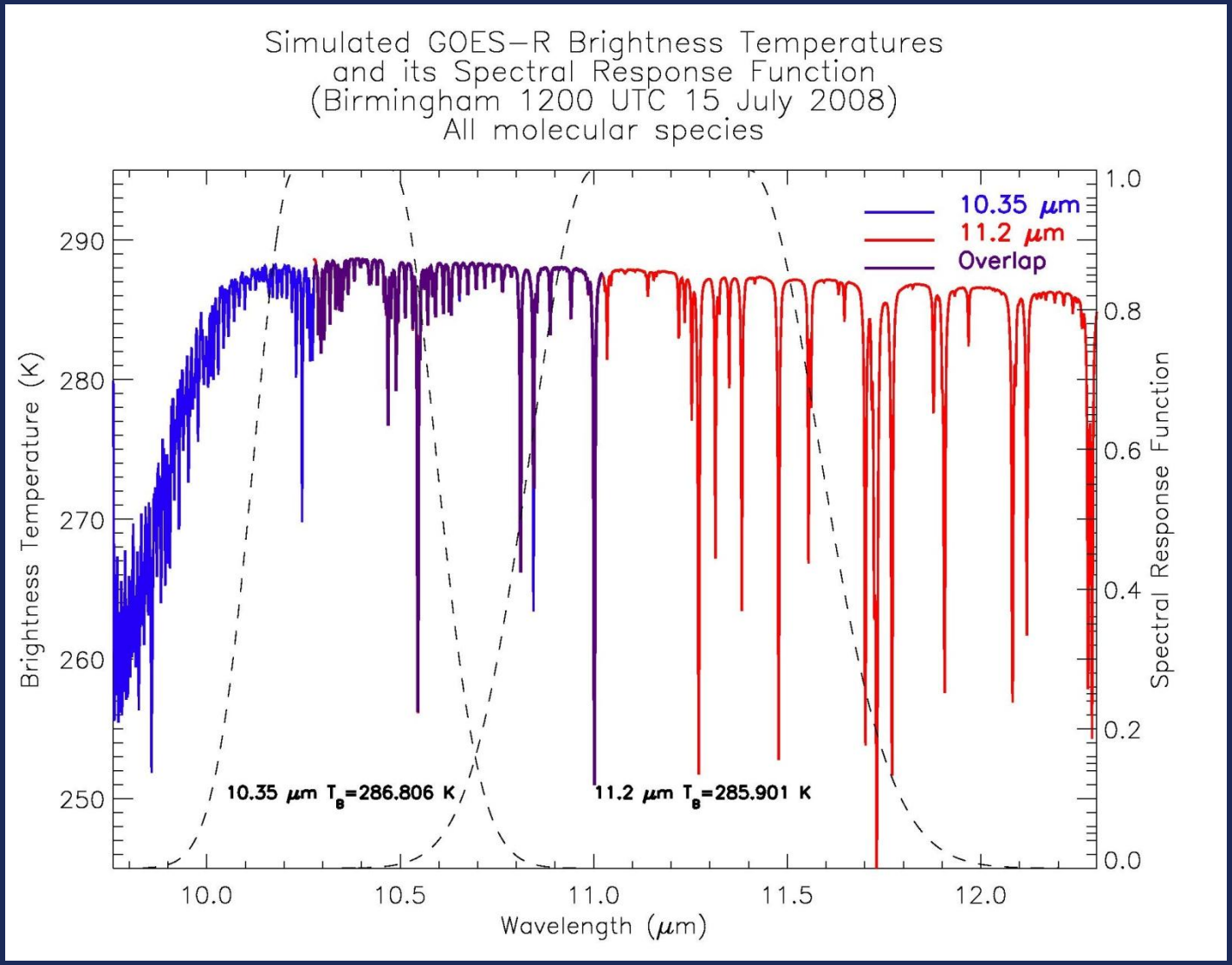
Line-by-line Calculations

Sounding used in forthcoming simulations



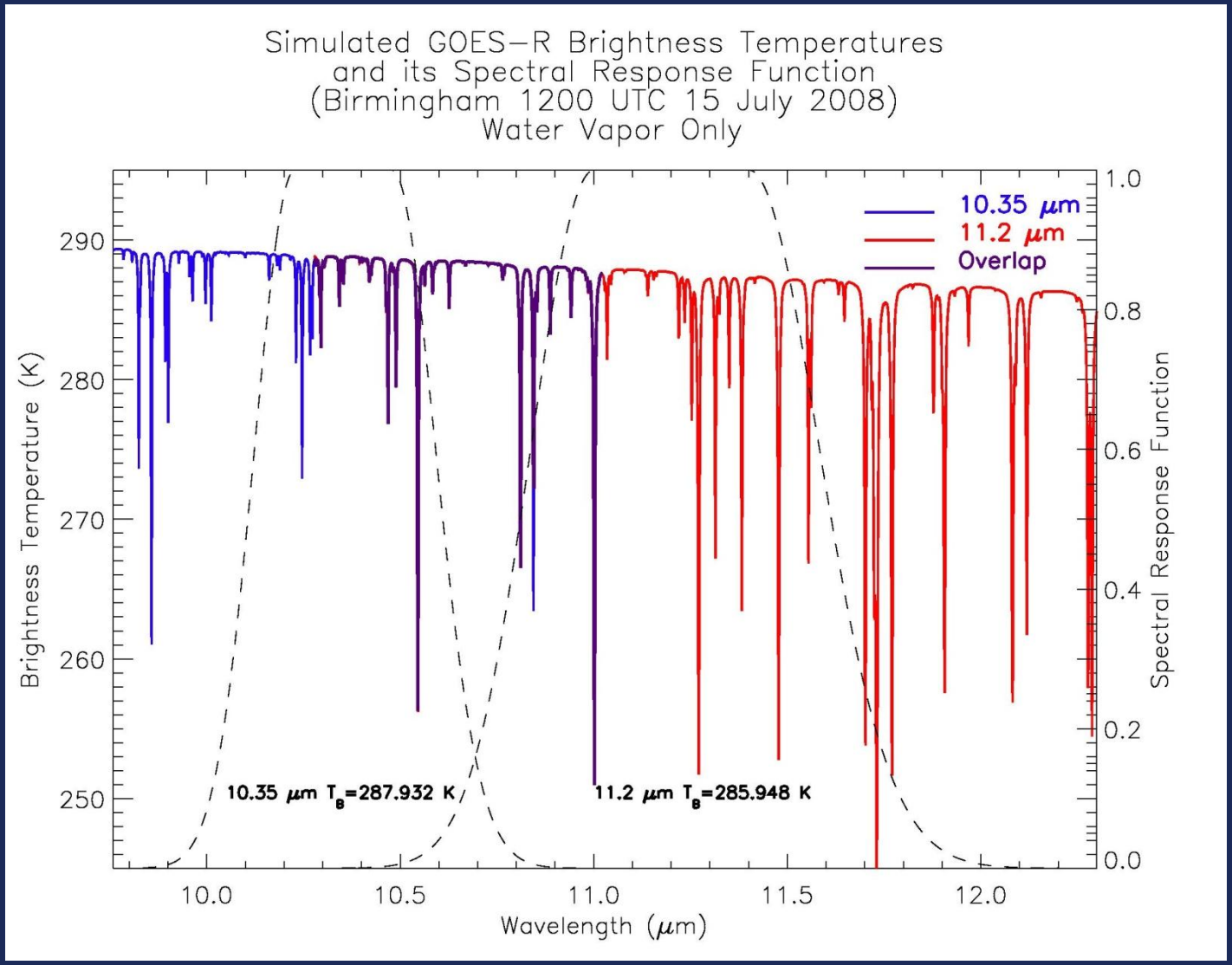
Line-by-line Calculations

All Species



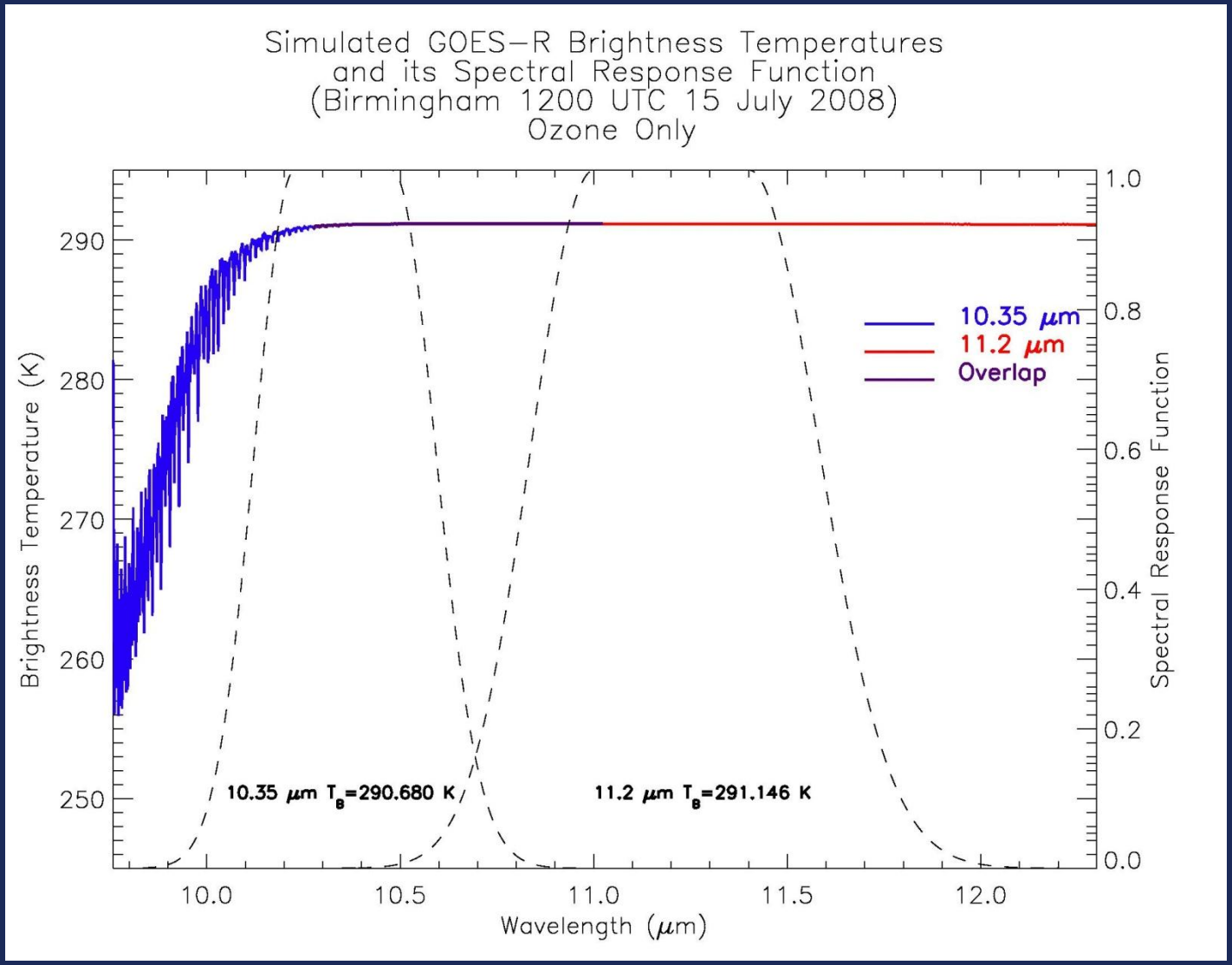
Line-by-line Calculations

Water Vapor Only



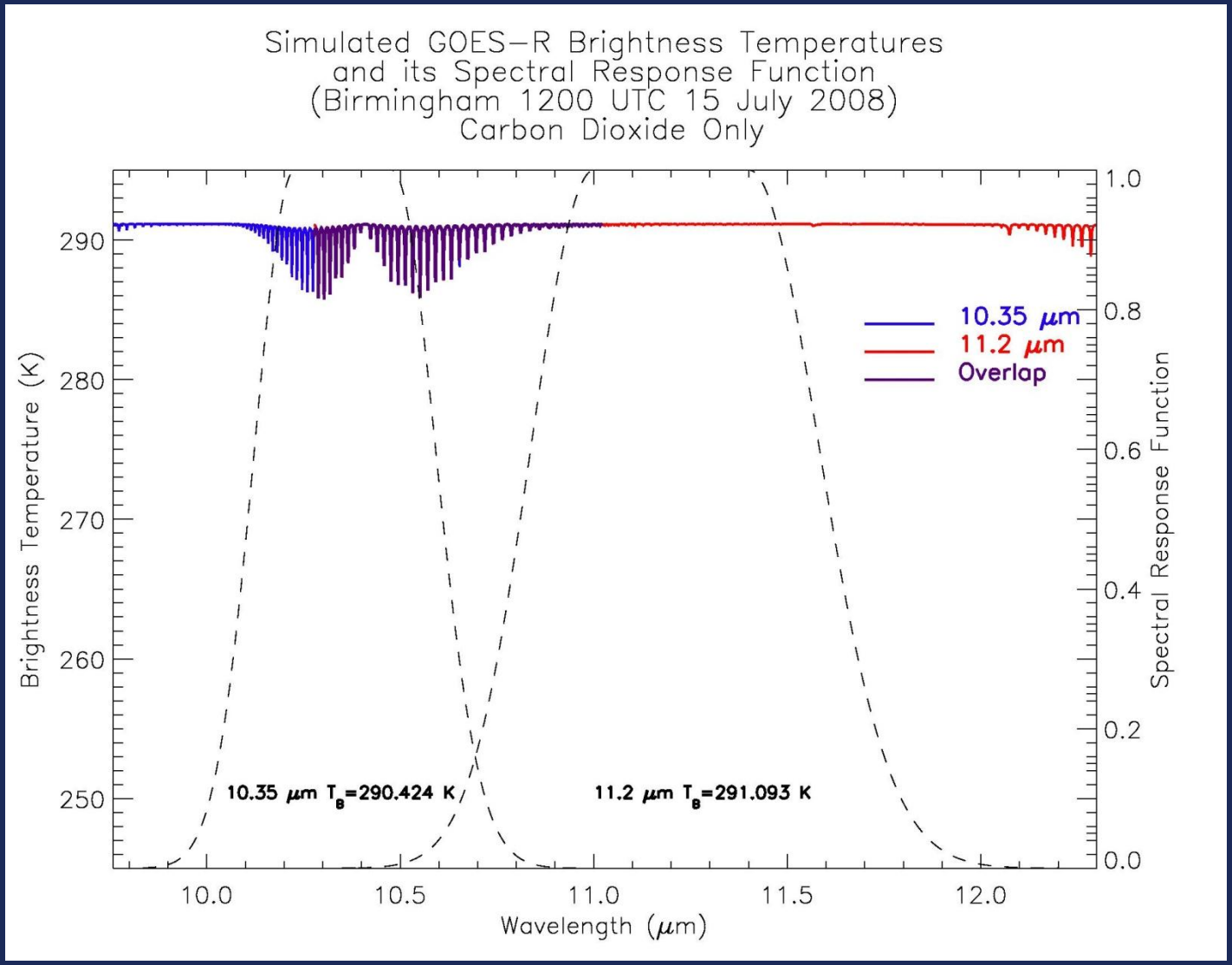
Line-by-line Calculations

Ozone Only



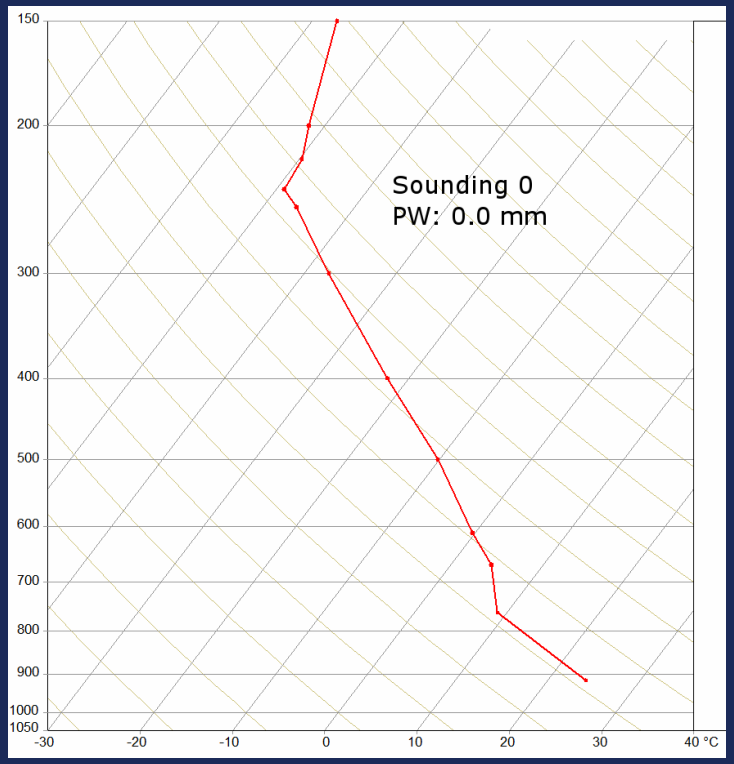
Line-by-line Calculations

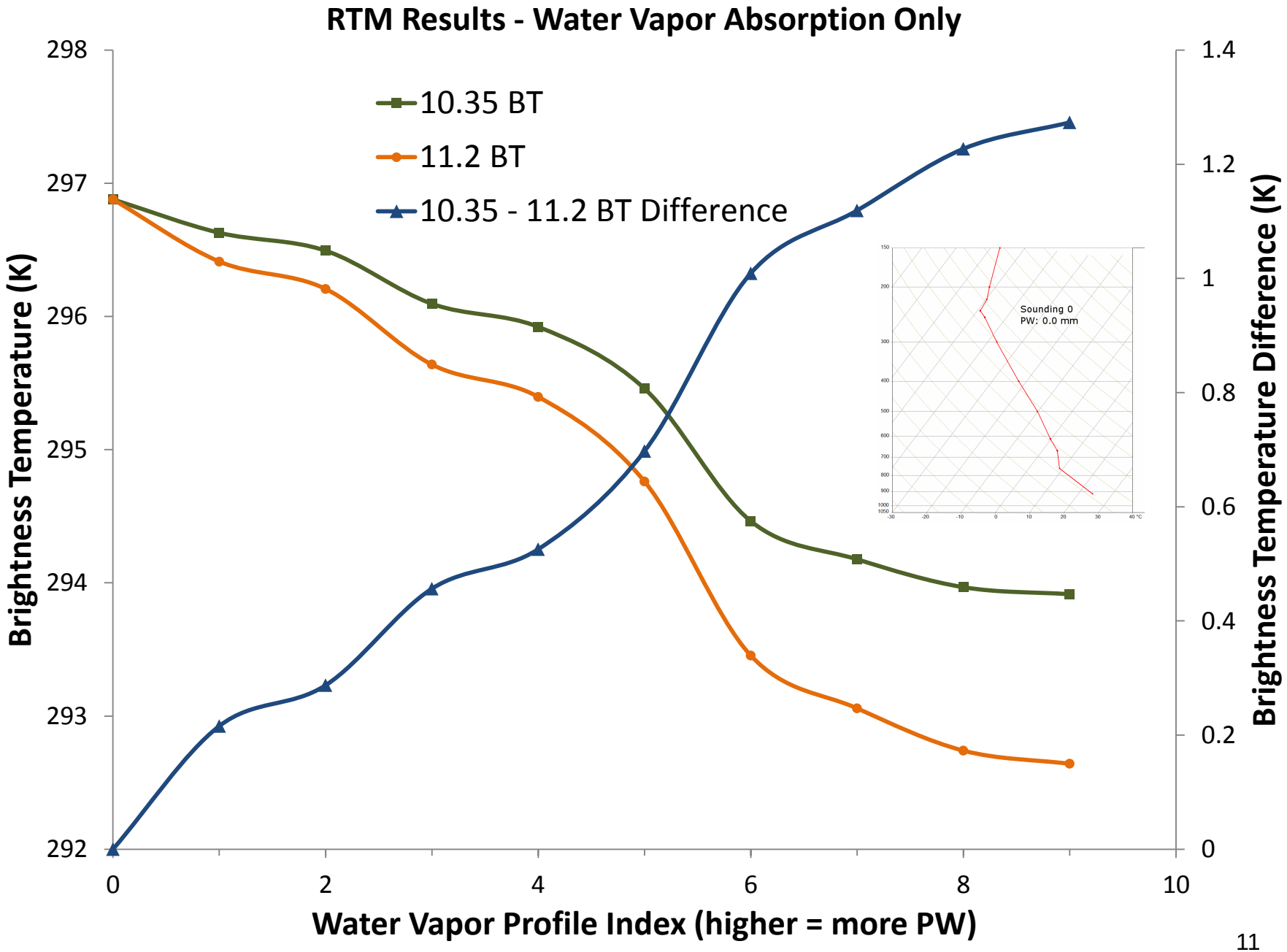
CO_2 Only

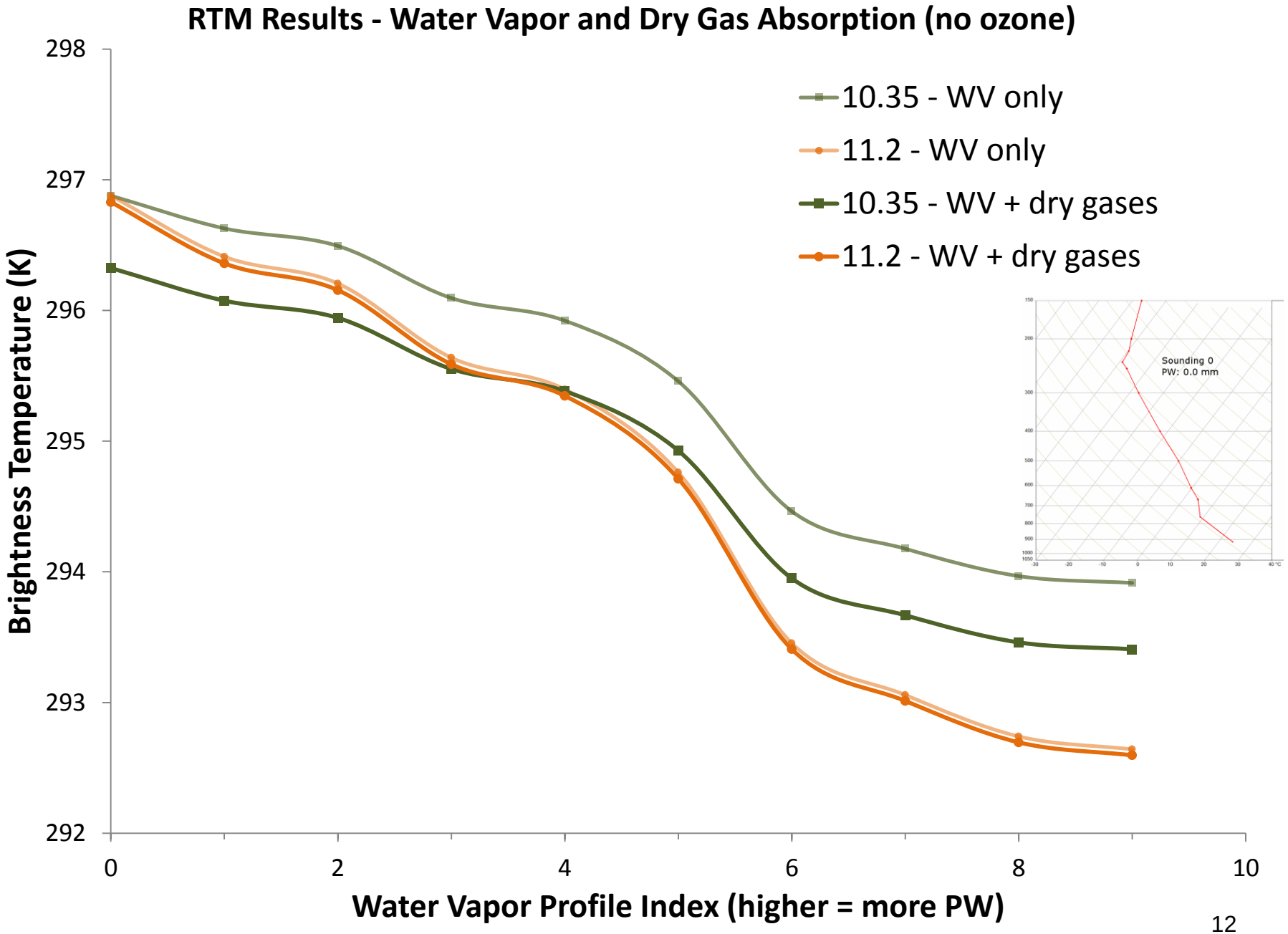


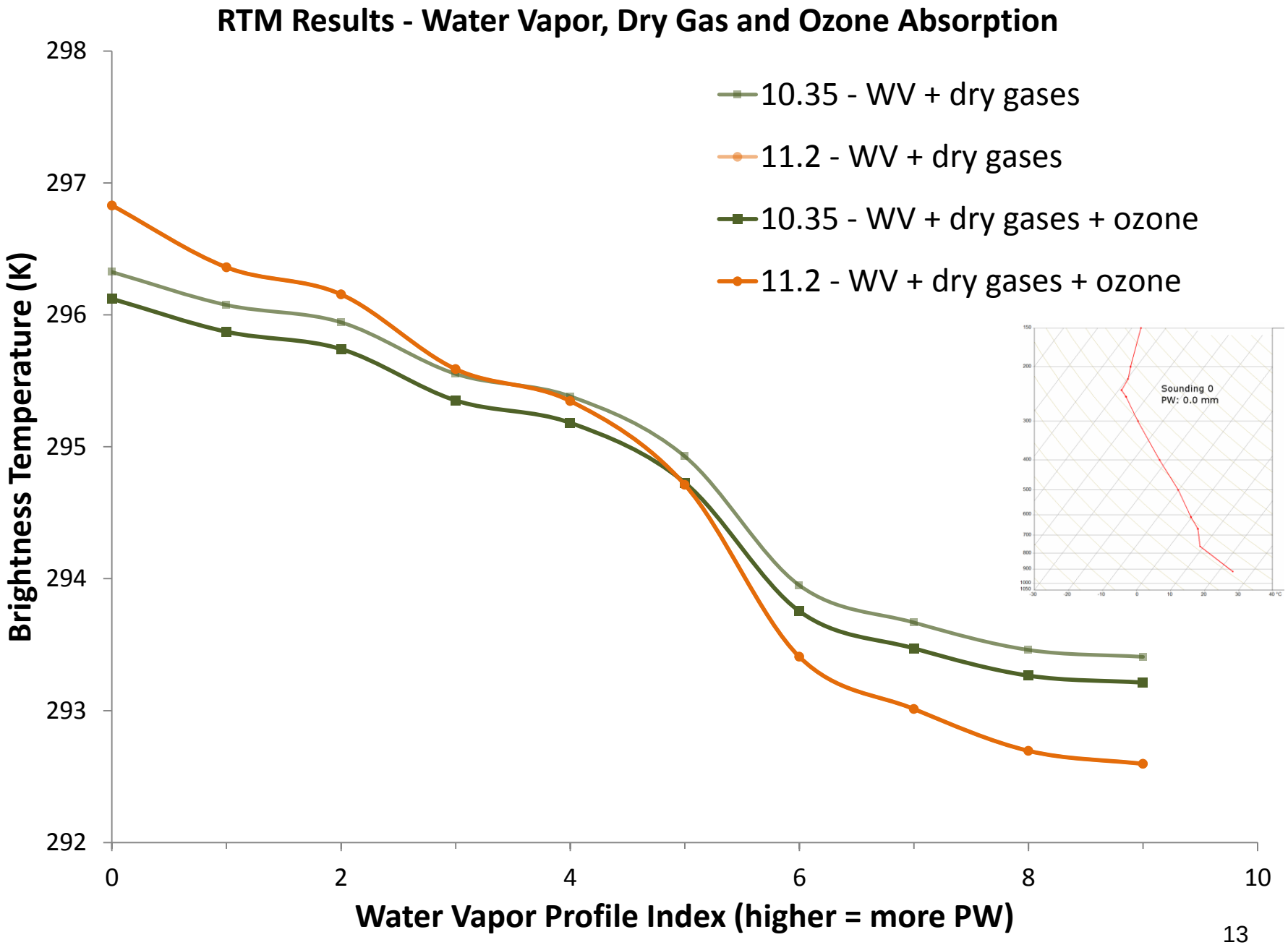
Forward Model Calculations

- To investigate each band's sensitivity to water vapor, we fixed a temperature sounding, then varied the water vapor vertical profile
- The forward model is OPTRAN
  - Gaseous absorption is calculated
  - The ABI spectral response functions are taken into account



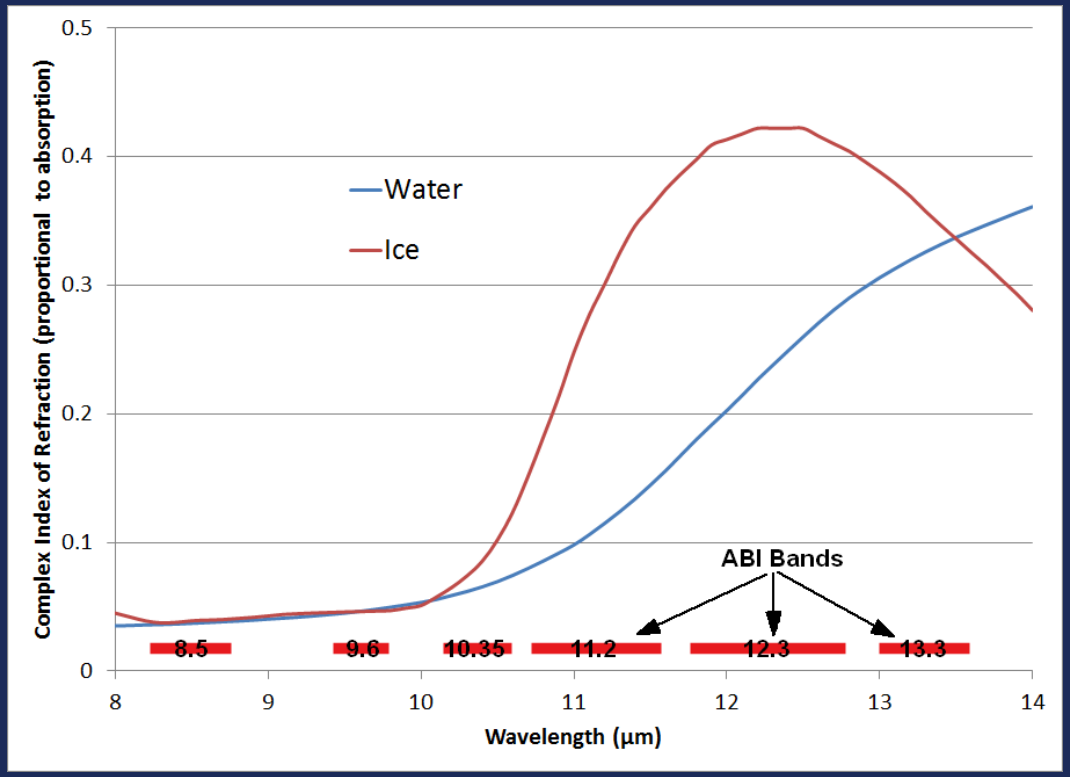

RTM Results - Water Vapor Absorption Only
10.35 BT
11.2 BT
10.35 - 11.2 BT Difference
Sounding 0
PW: 0.0 mm
Brightness Temperature (K)
Brightness Temperature Difference (K)
Water Vapor Profile Index (higher = more PW)
298
297
296
295
294
293
292
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10


RTM Results - Water Vapor and Dry Gas Absorption (no ozone)
10.35 - WV only
11.2 - WV only
10.35 - WV + dry gases
11.2 - WV + dry gases
Brightness Temperature (K)
298
297
296
295
294
293
292
0
2
4
6
8
10
Water Vapor Profile Index (higher = more PW)
Sounding 0
PW: 0.0 mm


RTM Results - Water Vapor, Dry Gas and Ozone Absorption
10.35 - WV + dry gases
11.2 - WV + dry gases
10.35 - WV + dry gases + ozone
11.2 - WV + dry gases + ozone
Brightness Temperature (K)
298
297
296
295
294
293
292
0
2
4
6
8
10
Water Vapor Profile Index (higher = more PW)
Sounding 0
PW: 0.0 mm

Cloud Observations

- When observing clouds, emissivity and transmissivity become more important than water vapor absorption
- For example, note in the plot below that water and ice clouds have different absorption characteristics at 11.2 µm compared to 10.35 µm (or 8.5 µm)
- These properties are taken advantage of in retrievals of various cloud properties, such as cloud phase



Conclusions

1. **What are the relative advantages of the 10.35 and 11.2 μm channels?**
   - 10.35 μm has a little ozone and CO_2 absorption, but less water vapor absorption than 11.2 μm
2. **Should one of them be the "default" Window IR Band?**
   - Given that it's cleaner (with respect to water vapor), 10.35 μm is better to use when trying to estimate the radiating temperature of a low-level feature
   - Corrections for ozone and CO_2 absorption should be small and easy to apply. RTM calculations show a 0.5-2 K cooling at 10.35 μm from these gases
3. **For algorithm development, which Window band is more appropriate, or should both be used?**
   - Both! Each band has unique characteristics that can be taken advantage of in atmospheric retrievals
   - The majority of current GOES-R Algorithms use only the 11.2 μm band, but we recommend making use of both Window bands to capture the advantages of each